



Science Education in the Kindergarten Classroom

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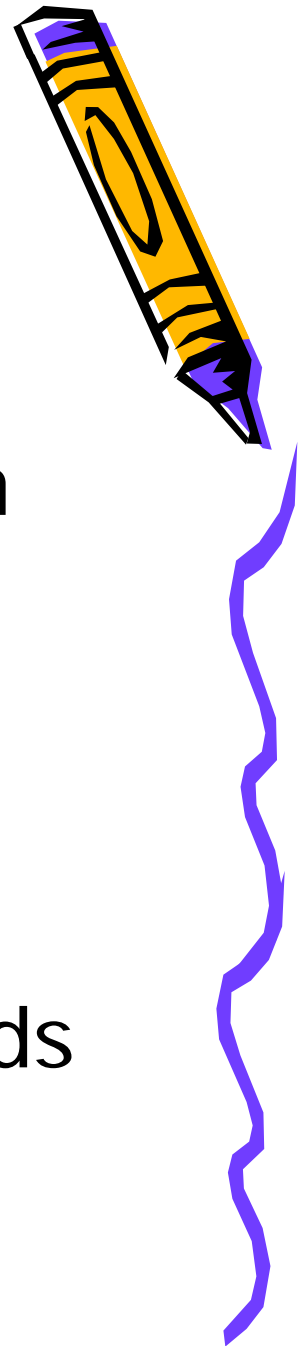
Montana Standards-Based Education Framework to Improve Learning and Teaching



<div>K-12 Content Standards</div> <div>What all Montana students will know, understand and be able to do when they graduate from high school ready for work and postsecondary education.</div>												
<div>Benchmarks</div> <div>Check points along the K-12 learning continuum to assess student progress toward meeting standards.</div>												
End of Grade 4				End of Grade 8				Upon Graduation/ End of Grade 12				
<div>Performance Descriptors</div> <div>How well students apply knowledge, skills and abilities.</div>												
Novice			Nearing Proficiency			Proficient			Advanced			
Grade 4	Grade 8	Grade 12	Grade 4	Grade 8	Grade 12	Grade 4	Grade 8	Grade 12	Grade 4	Grade 8	Grade 12	
<div>Grade Level Expectations</div> <div>Student learning expectations for each grade at the proficient performance level.</div>												
PK	K	1	2	3	4	5	6	7-8	9-10	11-12		
<div>Essential Learning Expectations - Knowledge/Skills/Abilities</div> <div>The necessary content, context and thinking and reasoning skills students must comprehend and apply along the learning continuum.</div>												
PK	K	1	2	3	4	5	6	7-8	9-10	11-12		
<div>Implications for Implementation</div>												
Model Curriculum				Research-based Instructional Strategies				Model Classroom Assessment				
Ongoing Professional Development using statewide, regional and local delivery venues												
<div>Educator Preparation Programs</div> <div>Initial and Advanced Educator Programs and Professional Development</div>												



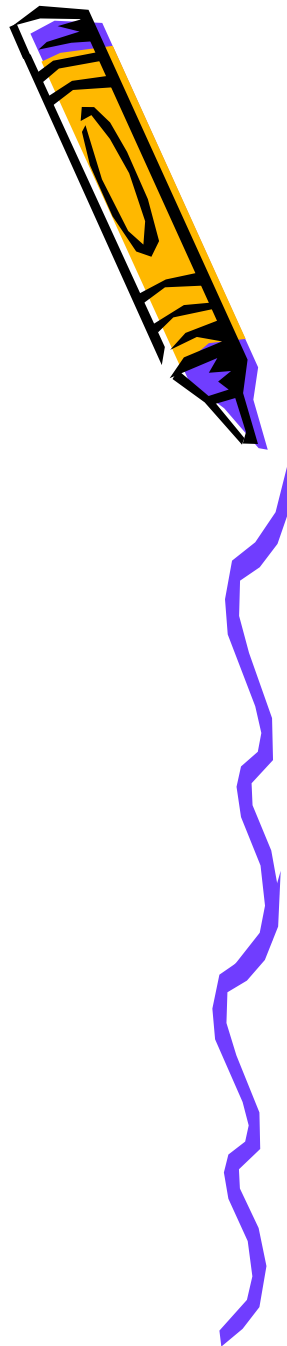
What do you know about the Montana State Science Content Standards?



- Revised in 2006
- Montana Board of Public Education under direction of Administrative Rules of Montana
- OPI assembled K-16 Montana educators to write the revision
- National Science Content Standards



What do you know about inquiry science?



Revised Montana Science Content Standards and Performance Descriptors



- Standards 1 through 5 indicate a push towards inquiry science.
- Rationale
 - Body of knowledge is ever changing, major concepts and processes are constant
 - Uncover students' prior knowledge & corrects misconceptions
 - Challenges students to construct knowledge & solve problems through observation and inferences
 - Students acquire and apply critical thinking and problem-solving skills as they work with others
 - Students assume responsibility of their learning



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What might inquiry look like in the kindergarten classroom?



Fortune Teller Fish Activity

Observe your fish- draw it

If we want to learn more about the fish what questions could we ask it?

What causes this fish to move? (testable question)

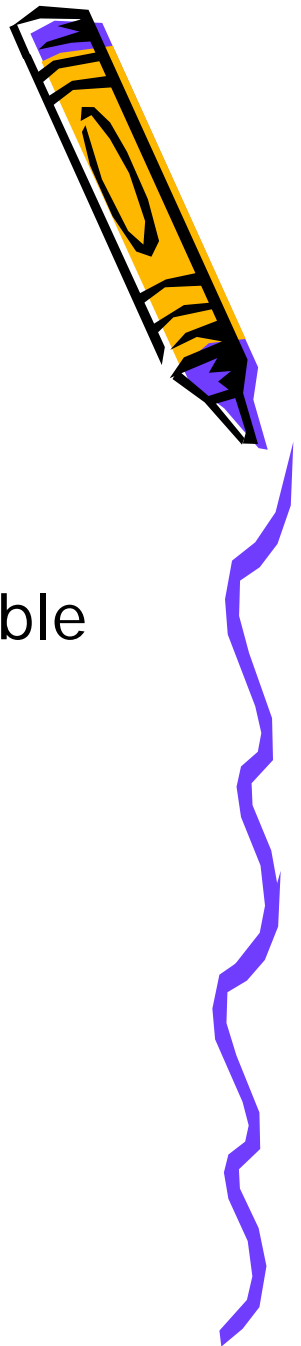
How can we gather more information about the movement of the fish?

What do these new observations tell us about the fish?





Fortune Teller Fish

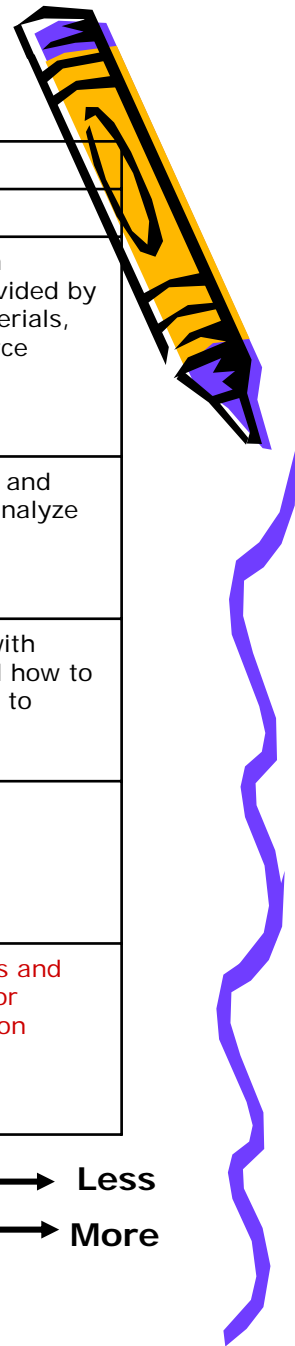


- o Science Content Standard 1:
Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- o Inquiry Continuum- essential features of classroom inquiry
- o 5 E's Instructional Model



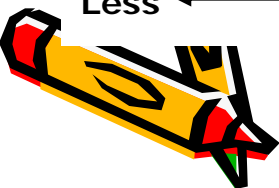
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Montana K-12 Content Standards and Performance Descriptors for Science – Inquiry Continuum



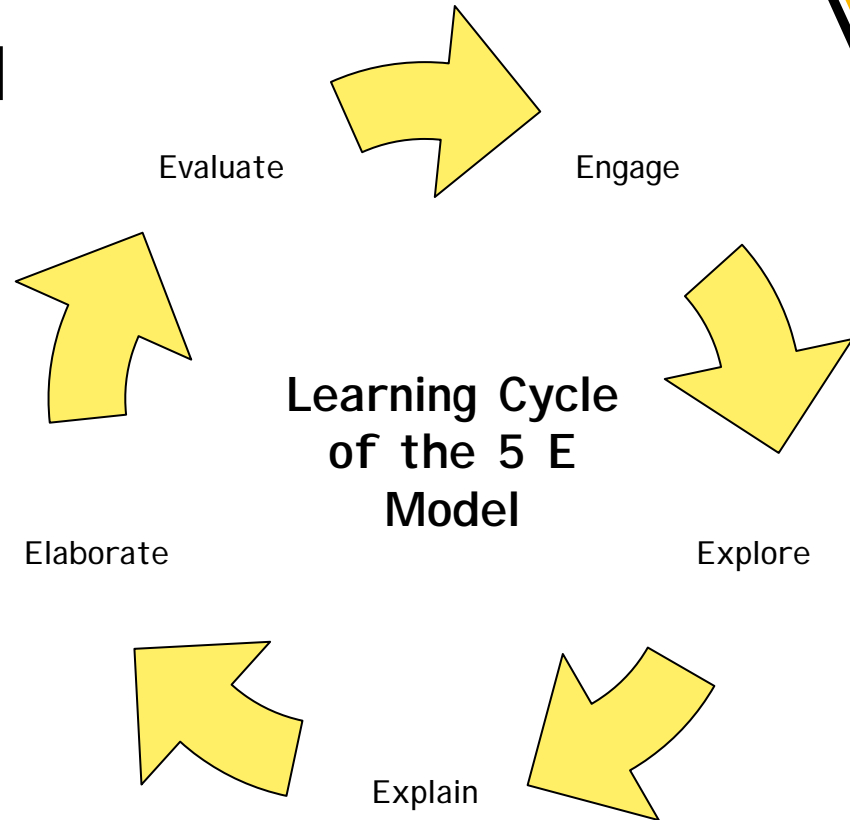
Essential Features of Classroom Inquiry and Their Variations				
Essential Feature	Variations			
1. Learner engages in scientifically oriented questions	Learner poses a question	Learner selects among questions, poses new questions	Learner sharpens or clarifies question provided by teacher, materials, or other source	Learner engages in question provided by teacher, materials, or other source
2. Learner gives priority to evidence in responding to questions	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyze	Learner given data and told how to analyze
3. Learner formulates explanations from evidence	Learner formulates explanations after summarizing evidence	Learner guided in process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanation	Learner provided with evidence and how to use evidence to formulate explanation
4. Learner connects explanations to scientific knowledge	Learner independently examines other resources and forms the links to explanations	Learner directed toward areas and sources of scientific knowledge	Learner given possible connections	
5. Learner communicates and justifies explanations	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to use to sharpen communication	Learner given steps and procedures for communication

More ← Amount of Learner Self-Direction → Less
 Less ← Amount of Direction from Teacher or Material → More



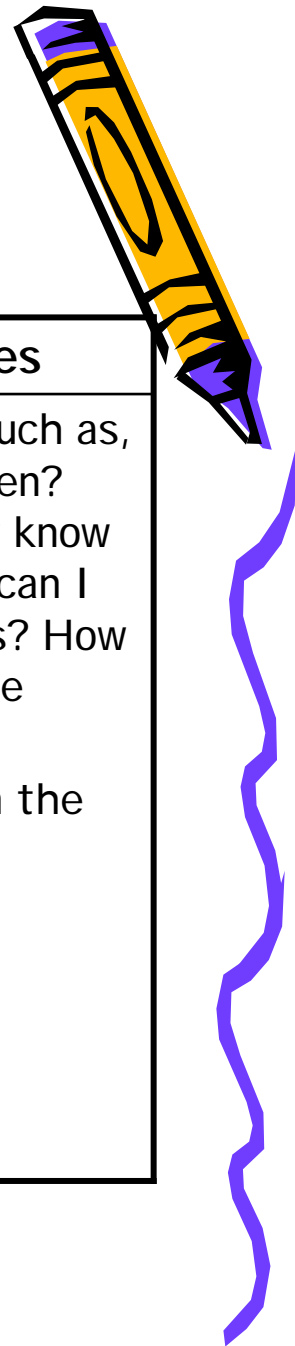
5 E Instructional Model

- Originally proposed by Biological Science Curriculum Study (BSCS)
- Model has applications in multiple content areas
- Learning cycle



Example of Inquiry Methodology:

5 E Instructional Model

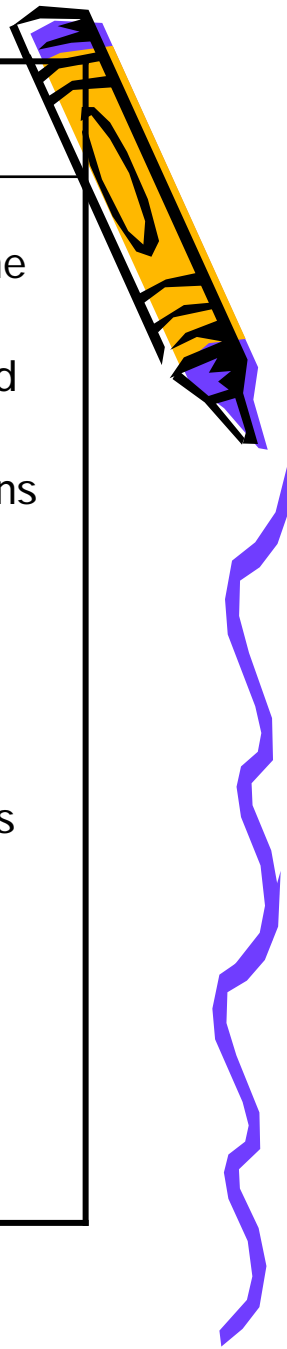


Phase of the Model	Teacher Does	Student Does
ENGAGE Initiates the learning task. The activity should make connections between past and present learning experiences, and anticipate activities and organize students' thinking towards the learning outcomes and current activities.	<ul style="list-style-type: none">▪creates interest▪generates curiosity▪raises questions and problems▪elicits responses that uncover students' current knowledge about the concept/topic	<ul style="list-style-type: none">▪ asks questions such as, Why did this happen? What do I already know about this? What can I find out about this? How can this problem be solved?▪ shows interest in the topic

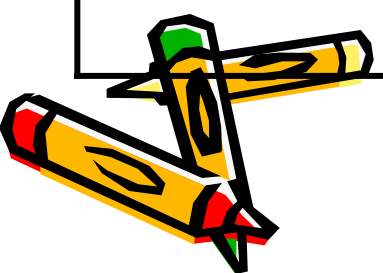
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Phase of the Model	Teacher Does	Student Does
<p>EXPLORE</p> <p>Provide students with a common base of experiences within which current concepts, processes, and skills are identified and developed</p>	<ul style="list-style-type: none"> ▪ encourages students to work together without direct instruction from the teacher. ▪ observes and listens to students as they interact. ▪ asks probing questions to redirect students' investigations when necessary. ▪ provides time for students to puzzle through problems. ▪ act as a consultant for students 	<ul style="list-style-type: none"> ▪ thinks creatively within the limits of the activity ▪ tests predictions and hypotheses ▪ forms new predictions and hypotheses ▪ tries alternatives to solve a problem and discusses them with others ▪ records observations and ideas ▪ suspends judgment ▪ tests ideas



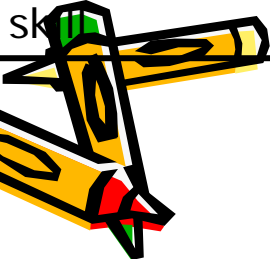
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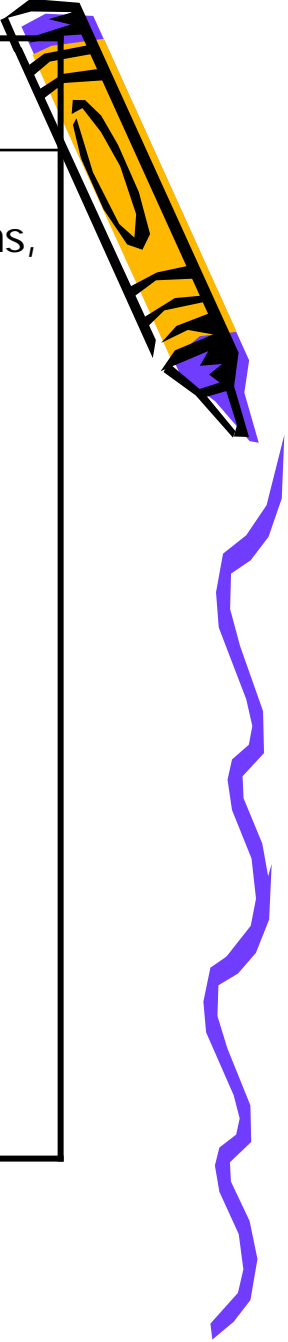
Phase of the Model	Teacher Does	Student Does
<p>EXPLAIN</p> <p>Focus student's attention on a particular aspect of their engagement and exploration experiences, and provide opportunities to demonstrate their conceptual understanding, process skills, or behaviors. This phase also provides opportunities for teachers to introduce a concept, process, or skill.</p>	<ul style="list-style-type: none"> ▪ encourages students to explain concepts and definitions in their own words. ▪ asks for justification (evidence) and clarification from students ▪ formally provides definitions, explanations, and new vocabulary ▪ uses students' previous experiences as the basis for explaining concepts 	<ul style="list-style-type: none"> ▪ explains possible solutions or answers to other students ▪ listens critically to other students' explanations ▪ questions other students' explanations ▪ listens to and tries to comprehend explanations offered by the teacher ▪ refers to previous activities



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Phase of the Model	Teacher Does	Student Does
<p>ELABORATE</p> <p>Challenge and extend students' conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information, and adequate skills</p>	<ul style="list-style-type: none"> ▪ expects students to use vocabulary, definitions, and explanations provided previously in new context ▪ encourage students to apply the concepts and skills in new situations ▪ remind students of alternative explanations ▪ refers students to alternative explanations 	<ul style="list-style-type: none"> ▪ applies new labels, definitions, explanations, and skills in new, but similar, situations ▪ uses previous information to ask questions, propose solutions, make decisions, design experiments ▪ draws reasonable conclusions from evidence ▪ records observations and explanations



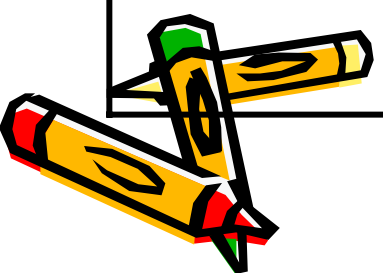
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Phase of the Model	Teacher Does	Student Does
<p>EVALUATE</p> <p>Encourage students to assess their understanding and abilities and provide opportunities for teachers to evaluate student progress.</p>	<ul style="list-style-type: none"> ▪ refers students to existing data and evidence and asks, "What do you already know?" Why do you think ...? ▪ observes students as they apply new concepts and skills ▪ assesses students' knowledge and/or skills ▪ looks for evidence that students have changed their thinking ▪ allows students to assess their learning and group process skills ▪ asks open-ended questions such as, Why do you think...? What evidence do you have? What do you know about the problem? How would you answer the question 	<ul style="list-style-type: none"> ▪ checks for understanding among peers ▪ answers open-ended questions by using observations, evidence, and previously accepted explanations ▪ demonstrates an understanding or knowledge of the concept or skill ▪ evaluates his or her own progress and knowledge ▪ asks related questions that would encourage future investigations



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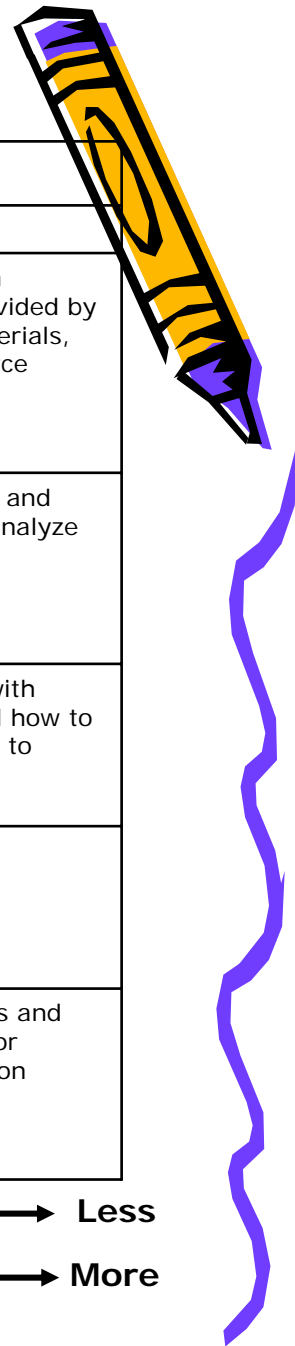


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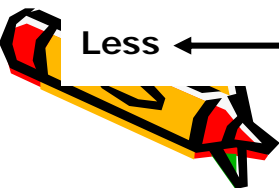
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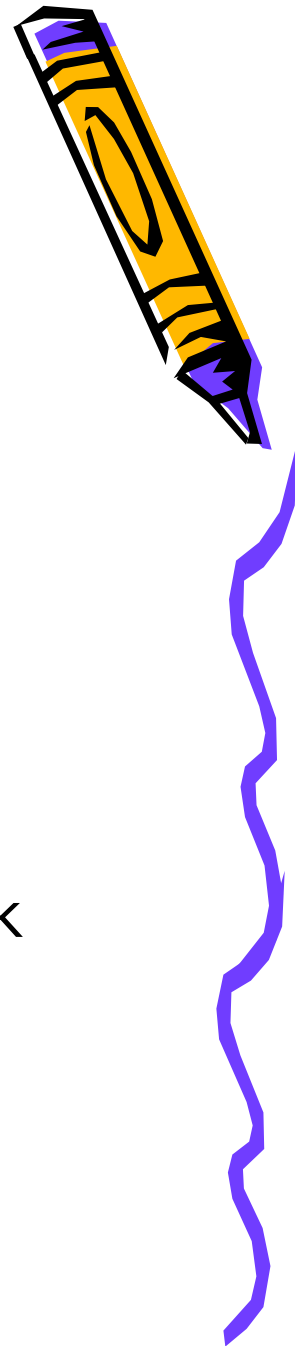
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4. Learner connects explanations to scientific knowledge Elaborate	Learner independently examines other resources and forms the links to explanations	Learner directed toward areas and sources of scientific knowledge	Learner given possible connections	
5. Learner communicates and justifies explanations Evaluate	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to use to sharpen communication	Learner given steps and procedures for communication

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Tips For Managing Inquiry



- Discussion Etiquette
- Method for Materials
- Safety contracts
- Have a Question Place/Word Wall
- Science Journals
- Assign Roles/Tasks
- Checkpoint Labs
 - Divide into sections, spot for teacher check mark or stamp
 - Red cup and green cup



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What is happening at OPI that pertains to science education?

- o Drafting of Essential Learning Expectations
- o Implementation of Professional Development for Revised Science Content Standards
- o Implications for Implementation (to come in the future)
 - o Model curriculum
 - o Researched-based instructional strategies
 - o Model assessments



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Essential Learning Expectations

- *ELEs include the specific content knowledge, abilities, and skills that students "must know and do" at the end of each grade in each content area.*
- Drafted the end of June for Science, Library Media/Information Literacy, and Technology
 - Developed by K-12 Montana teachers in those content areas
 - Documents are currently in the stages of clean up and then will be evaluated for vertical alignment and content.



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Montana Instructional Alignment - Science
Grade Level: Kindergarten

Content Standards

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

Content Standard	Benchmark End of Grade 4	Grade Level Expectation Grade K	Objective Student will:	Essential Learning Expectations Grade K	Essential Vocabulary	Assessment	Materials/ Resources	Links to Lesson Plans & Professional Development
1. Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.	1.1 Develop the abilities necessary to safely conduct scientific inquiry, including (a step-by-step sequence is not implied): (a) asking questions about objects, events, and organisms in the environment, (b) planning and conducting simple investigations.	1. Asks appropriate questions after sharing a common experience.	Report observations made during the inquiry process.	<ul style="list-style-type: none"> •recognize a question •construct a relevant question •explain different ways of observing •make an observation •orally report finding of an observation using the inquiry process. 	question, hypothesis, procedure (engage, explore, explain, extend, evaluate), results/conclusion, investigation, scientific method, inquiry, experiment, simple (2 variables)			

Professional Development Implementation Levels for Revised Montana Science Content Standards and Performance Descriptors

Level I

Professional development at this level is designed to provide the basic introduction and orientation to the revised Montana Science Content Standards and Performance Descriptors

Training at this level is intended to:

- Identify, explore and develop an awareness and a basic understanding of:
 1. Montana Science Content and Performance Standards
 - a. Rationale for revisions
 - b. Research supporting revisions
 - c. Integration of Indian Education for All (IEFA)
 - d. Alignment with state criterion reference test for science (CRT)
 2. Inquiry-based Instruction
 - a. Rationale
 - b. Research base
 - c. Inquiry continuum
 - d. Example of inquiry lesson
- Examine selected resources for inquiry-based instruction
- Be a minimum of 2 ½ to 3 hours in length

Goal: All applicable school personnel in Montana will have the opportunity to receive Level I professional development by the end of 2009-2010 school year.

Level II

Professional development at this level provides high quality, job-embedded training in strategies for developing, implementing and evaluating

learning experiences that:

- are standards-based
- integrate Indian Education for All
- exemplify best instructional practice

Level III

Professional development at this level seeks to create and sustain a network of experienced Montana science educators who advocate and

disseminate the ideas and methods that exemplify best instructional practices.



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